

REMARKS

Claims 1-20 are pending in the present application. Claims 1 and 19-20 have been amended to explicitly recite what was implicit and/or to correct informalities. Amendments to the claims are not intended to limit the scope of the invention or overcome any cited art. No new matter has been added.

Objections to the Specification

The specification has been objected to on the ground that "it does not clearly describe the functionalities of the invention." (January 17, 2006 Office action, pg. 2). Specifically, the Office action states:

[A]pplicant's disclosure describes the use of desktop class disks as enterprise class disks (page 3, lines 14-15) by limiting performance of desktop class disk drives to avoid exceeding duty cycle rating of the disk drives (page 3, lines 16-18). According to the applicant's detailed description, the disclosed invention causes desktop disk drives to operate at or below their intended duty cycle rate by delaying subsequent commands to the disk drive whenever the duty cycle rate is exceeded (figures 2, 3; page 6, lines 10-16). However, the examiner asserts that if these desktop class disk drives (approximately 30% duty cycle; page 2, line 12) are used as enterprise class disk drives (70-80% duty cycle; page 2, line 5) as stated by the applicant, the drives would cause a backlog of commands due to the delay mechanism disclosed by the applicant. Using the examples given by the applicant, if an enterprise class storage system that normally has duty cycle of 70% uses applicant's disclosed invention, limiting duty cycle to 30%, then 40% of the workload would be delayed and accumulate into a backlog. Although short-term delays in the milliseconds range are generally acceptable as they are unnoticeable to the user, continual usage of the system appear to cause increasing larger delays. For example, if the above system is used over a relatively long period of time 10 hours, during which a 70% duty cycle is required but only 30% is performed by the system, then roughly 4 hours of work (40% of 10 hours) would accumulate as backlog. This would mean a new command requiring access to the storage system would have to wait 4 hours before the command can be processed. One of ordinary skill in the art at the time of invention would recognize that the **delay would render the system impractical for enterprise class usage**, as intended by the applicant. The examiner recognizes that these duty rates are hypothetical, and that actual usage might or might not have the

above problem depending on whether long-term duty cycle is above the limit set by the system. Based on this reasoning, the examiner raises the following two questions which the specification does not clearly present resolutions for:

- a. If the system is used in an enterprise storage application in which the duty cycle required in the long term is above the duty cycle limit set by the system, then how does the system account for the increasingly larger backlog and corresponding delay?
- b. If the system is used in an enterprise storage application in which the duty cycle required in the long term is equal or below the duty cycle limit set by the system, then how does the invention increase reliability and quality of the storage system if the problem of exceeding the duty cycle that the system is designed to solve does not exist?

(January 17, 2006 Office action, pgs. 2-3).

As noted in the background section of the specification, the motivation behind the present invention is the realization that although desktop class disk drives are not meant for enterprise applications with high duty cycles, "there is nothing that prevents them from being used in applications that exceed the rated duty cycle of these disks." (Pg. 2, lns. 21-22 of the Specification). Exceeding the rated duty cycle of disk drives usually leads to failure of those disk drives. Thus, higher than projected disk drive failure rates will result if more desktop class disk drives are utilized in high duty cycle enterprise applications.

Higher disk drive failure rates can lead to increased costs and decreased profits for storage system manufacturers due to higher warranty expenses. (See pg. 2, ln. 22 to pg. 3, ln. 2 of the Specification). In addition, a perception of poor quality and reliability may result from higher disk drive failure rates, which may lead to loss of customers and further decrease in profits.

With all of the above in mind, applicants conceived of the present invention to prevent end-users from exceeding the rated duty cycle of desktop class disk drives in an effort to avoid

premature disk drive failures. (*See* pg. 5, lns. 1-3 of the Specification). The goal of the present invention is to improve the quality and reliability of desktop class disk drives, even if it is at the expense of other concerns, such as performance. (*See* pg. 3, lns. 10-11 of the Specification).

Therefore, if a desktop class disk drive is used in a high duty cycle enterprise application, even though it may not be designed to be used as such, one of ordinary skill in the art at the time of invention would recognize that in order to maintain quality and reliability while saving money, there will be performance tradeoffs. Further, one of ordinary skill in the art at the time of invention would also recognize that two or more desktop class disk drive can be used to share the workload of a high duty cycle enterprise application, which would address performance concerns and still be more economical than purchasing a single enterprise class disk drive that “generally cost[s] 3 or 6 times more per gigabyte (GB) of capacity.” (Pg. 2, lns. 5-6 of the Specification).

For enterprise applications that have average duty cycles at or below the rated duty cycle of desktop class disk drives, one of ordinary skill in the art at the time of invention would further recognize that there will still be times where the desktop class disk drives are subjected to heavier workloads and as a result exceed their rated duty cycles. By limiting performance based on the rated duty cycle of a desktop class disk drive, the present invention is able to even out workloads, which reduces the amount of time the disk drive is operating above its rated duty cycle. One of ordinary skill in the art at the time of invention would also recognize that reducing the amount of time a disk drive is exceeding its rated duty cycle will improve quality and reliability in view of applicants’ specification.

Accordingly, based at least on the reasons above, applicants respectfully submit that the specification does clearly describe the functionalities of the invention.

§ 101 Rejections

Claims 1-9 and 19-20 have been rejected under 35 U.S.C. § 101 as describing “a method that is not limited to tangible embodiments.” (January 17, 2006 Office action, pg. 4). Claim 1 has been amended to recite a “computer implemented method” and claim 19 has been amended to recite a “computer readable medium containing a computer program tangibly stored thereon.”

Accordingly, based at least on the reasons above, applicants respectfully submit that claims 1 and 19, as amended, and the claims that depend therefrom, satisfy the requirements under 35 U.S.C. § 101.

§ 102 / § 103 Rejections

Claims 1-2, 10-11, and 19 have been rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,544,138 to Bajorek et al. Claims 3-4, 6-7, 12-13, and 15-16 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Bajorek in view of what is well known in the art. Claim 5 and 14 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Bajorek in view of U.S. Patent No. 5,682,273 to Hetzler.

Claims 1, 10, and 19 recite “limiting performance of read/write commands . . . based on whether a sufficient number of idle states has been monitored to avoid exceeding a duty cycle rating of the disk drive.” The Office action states:

Bajorak discloses . . . limiting performance of read/write commands by the disk drive (power down, column 10, lines 33-35) based on whether a sufficient number of idle states has been monitored (column 10, lines 14-21, 24-28) to avoid exceeding a duty cycle rating of the disk drive (column 1, lines 24-29). The examiner asserts Bajorak teaches “limiting the performance of read/write commands by the disk drive” because a powered down drive responds slower to read/write commands. The examiner also asserts that Bajorak teaches “based on

whether a sufficient number of idle states has been monitored” because each idle state causes an adjustment to a register value which is compared to a threshold in determining whether the disk drive should be powered down. The examiner further asserts that Bajorek teaches “avoiding exceeding a duty cycle rating of the disk drive” because Bajorek states explicitly reducing power also reduces the duty cycle of the disk drive.

(January 17, 2006 Office action, pg. 5).

Bajorek is directed to “[a] disk drive power manager that compares energy usage with a predetermined profile to select one of several reduced-power operating modes” (Abstract of Bajorek). Figure 13 of Bajorek clearly shows that “[i]f the system requests a disk drive apparatus operation, control is transferred to A2” (col. 10, lns. 23-24 of Bajorek). “[T]he transfer to A2 causes execution of the requested operation . . . , which powers-up to the fully-powered operational state . . .” (col. 10, lns. 55-57 of Bajorek). Thus, in Bajorek, only when “no operation is requested” can power-down be initiated (col. 10, lns. 24-29; figure 13 of Bajorek).

In claims 1, 10, and 19, however, it is the “performance of read/write commands” that is being limited. Hence, where Bajorek only powers down when there are no pending operation requests, the limiting step in claims 1, 10, and 19 is only applicable when there are pending read/write commands because otherwise there would be nothing to limit. Therefore, powering down of a drive in Bajorek cannot be construed as “limiting performance of read/write commands,” as recited in claims 1, 10, and 19.

Additionally, whether an idle disk drive powers down or not in Bajorek depends upon energy usage, not “whether a sufficient number of idle states has been monitored to avoid exceeding a duty cycle rating of the disk drive,” as recited in claims 1, 10, and 19. (See, e.g., col. 4, lns. 21-24 of Bajorek). Therefore, even though Bajorek notes in the background section that

one of the benefits of “reducing power consumption of an inactive disk drive” is the reduction of the duty cycle for the disk drive, it does not disclose, teach, or suggest, and the Office action has not cited any passage of Bajorek as disclosing, teaching, or suggesting, that powering down of a disk drive is based on whether a duty cycle rating of the disk drive has been exceeded.

Accordingly, based at least on the reasons above, applicants respectfully submit that claims 1, 10, and 19, and the claims that depend therefrom, are not anticipated by Bajorek. Since the Office action fails to cite anything well known in the art that would cure the deficiencies of Bajorek, applicants respectfully submit that claims 1, 10, and 19, and the claims that depend therefrom, are also patentable over Bajorek in view of what is well known in the art.

Hetzler likewise fails to cure the deficiencies of Bajorek. Hetzler is directed to disk drives that “perform power management from past disk drive access history and a prediction of future user demands to determine the power-save mode entry and exit times” (col. 2, lns. 16-19 of Hetzler). As with Bajorek, Hetzler does not disclose, teach, or suggest, and the Office action does not cite any passage of Hetzler as disclosing, teaching, or suggesting, “limiting performance of read/write commands . . . based on whether a sufficient number of idle states has been monitored to avoid exceeding a duty cycle rating of the disk drive,” as recited in claims 1, 10, and 19.

Therefore, even if Bajorek and Hetzler were combined, the combination would neither teach nor suggest “limiting performance of read/write commands . . . based on whether a sufficient number of idle states has been monitored to avoid exceeding a duty cycle rating of the disk drive,” as recited in claims 1, 10, and 19.

Accordingly, based at least on the reasons above, applicants respectfully submit that claims 1, 10, and 19, and the claims that depend therefrom, are patentable over Bajorck in view of Hetzler.

CONCLUSION

On the basis of the above remarks, reconsideration and allowance of the claims is believed to be warranted and such action is respectfully requested. If the Examiner has any questions or comments, the Examiner is respectfully requested to contact the undersigned at the number listed below.

Respectfully submitted,
SAWYER LAW GROUP LLP

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Erin C. Ming
Attorney for Applicant(s)
Reg. No. 47,797
(650) 475-1449